

DRAFT STATEMENT OF WORK FOR SCIENTIFIC VISUALIZATION STUDIO

1.0 Background

A scientific visualization is a visual representation of a physical phenomenon or of a relationship between physical phenomena. A scientific visualization almost always involves the conversion of numerical or visual data into new imagery clarifying such physical phenomena or relationships. This new imagery can be in electronic or physical form, can be static (a picture) or dynamic (an animation), and can be interactive or non-interactive. Scientific visualizations created to communicate must be designed to clearly and dramatically represent the concept to be communicated, while accurately conveying the data used to create the visualization. Scientific visualizations that enable discovery usually require less design and more interactivity and are often created by researchers themselves. Scientific visualization systems are computer-based systems that access data and create visualizations under interactive control of the user, or 'visualizer'. A scientific visualization process is a sequence of computer processes that create a pre-defined set of data visualizations automatically or on demand.

The Scientific Visualization Studio (SVS) is a NASA Goddard Space Flight Center-based group that produces scientific visualization products, systems, and processes that support NASA's scientific missions and research activities. This support is primarily for the purpose of communicating to the public the physical principles, research goals, mission objectives, engineering processes, and scientific discoveries associated with NASA and NASA-supported scientific endeavors. In certain cases, this support also has the purpose of enabling scientific discovery by providing visualization services directly to the research community. Almost all activities of this group involve the visualization of scientific data derived from remote sensing satellites, computational modeling, or research analysis. A critical aspect of this effort is collaboration with researchers, outreach experts, and external entities such as the media, documentary film producers, educational content providers, and informal education institutions such as museums and science centers. Such collaboration defines the specific requirements for the visualization products, systems, and processes to be created by a project.

In order to produce images and animations of the highest possible quality, the SVS has an internal visualization infrastructure similar to that of an animation studio or movie special-effects company. The current SVS infrastructure consists of a set of Linux and Mac OSX-based file servers, video servers, render servers, desktop design workstations, and video preview facilities. The primary software packages used in this infrastructure for creating and rendering visualizations are Autodesk's Maya and Pixar's RenderMan, with task scheduling through Pixar's Alfred or Tractor. Post-processing is often done with Adobe's Photoshop and After Effects. An element of almost all SVS work involves importing scientific data sets into this system so that it can be visualized, either by itself or in conjunction with other data sets. Pre-processing the data so that it can be imported is often performed in ITT's IDL software, although ad hoc tools and in-house-developed software developed in languages such as Python or C++ are often necessary. Much of the reusable data-visualization-specific software developed within the SVS is developed in Maya Embedded Language (MEL), RenderMan's Shading Language, Python, and IDL, with the result that the SVS infrastructure has highly specialized capabilities specific to its data visualization requirements. Visualization products produced by the SVS are most often delivered electronically. If the product is an animation then it is either as encoded in an appropriate video format such as MPEG or delivered as a frame set suitable for editing into a larger production. As an adjunct to project-specific product delivery, all SVS products are entered into an internally maintained database and made available to the public through a web server with access to that database.

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In addition to the internal infrastructure, the SVS also develops and maintains certain visualization systems for other groups at the Goddard Space Flight Center. At this time, there are two types of such systems. One type is a hyperwall, a multi-screen display backed by a Linux cluster on which ensembles of concurrent visualizations are displayed under interactive control. The other type is an on-demand visualization server, which uses established protocols such as WMS (Web Mapping Service) to deliver on-demand visualizations of data to external users. In both cases, the SVS develops, maintains, and improves the software for these systems based on customer requirements.

The SVS group consists of civil servants, contractors, and university personnel. Ad hoc groups based on specific expertise are formed within this set of personnel in order to accomplish visualization projects. These projects are often part of a larger group, one that include writers, producers, animators, cameramen, audio engineers, and discipline experts, most of whom are based at Goddard. Collaborations with personnel at other NASA centers and outside groups occurs regularly. Discussion and prioritization within this larger group determines the specific projects to be worked on, the relative priorities of such projects, and the individual visualizations that are part of each project.

2.0 Scope of Work

The basic objectives of this contract are to provide scientific visualization design, software programming, system implementation, and product delivery in support of specific SVS projects. The contractor shall perform this work primarily on-site at the NASA Goddard Space Flight Center as part of a team of civil servants, university personnel, and personnel from other contracts. The Government will provide general guidance as to priorities and level of effort, usually based on currently funded activities. The contractor shall, as part of this overall team,

refine these priorities and level of effort with respect to the activities of personnel on this contract, and will then oversee the product and/or system development assigned to such personnel. The Government will provide office space and the specialized computer systems, architecture, and software necessary to perform the work.

A critical aspect of this work involves interaction with collaborators. The contractor shall work closely with: other members of the SVS to design and create the required visualization products; dedicated researchers to assure that visualization products are scientifically accurate and effective for each specific project; the broader GSFC storytelling team to assure that products are delivered on schedule and ready for external distribution or internal use as defined by the project; external entities as directed by the Government in order to provide the broadest use of NASA results and SVS-created outreach products.

3.0 Statement of Work

The contractor shall:

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1. Create visualization products such as animations and images of Earth and space-based scientific data that convey the physical principles, research goals, mission objectives, engineering processes, and scientific discoveries associated with NASA and NASA-supported scientific endeavors. In order to create these products, the contractor shall:
 - 1.1. Accept both general and specific requirements for visualization products from contacts designated by the COTR and/or ATR and propose specific products that meet those requirements, along with the level of effort and schedule required to produce those products;
 - 1.2. Iterate on the content, design, format, schedule, and level of effort of these products with all relevant designated personnel as the specific project proceeds;
 - 1.3. Acquire the scientific data necessary for each particular visualization product and, if necessary, convert it to a form compatible with the SVS visualization processes, writing software to do so if required;
 - 1.4. Use the advanced image creation and rendering systems of the SVS infrastructure at NASA/GSFC to create the agreed-upon products by producing intermediate products as required for planning and development and final products as required by the product customer;
 - 1.5. Deliver products to SVS customers in formats compatible with their requirements;
 - 1.6. Publish all products within whatever system is designated as the general mechanism for SVS archiving and delivery, currently the SVS database/web server.
2. Develop visualization systems to enable personnel both internal and external to the SVS to create visualization products from scientific data. Specifically the contractor shall:
 - 2.1. Beginning from the existing SVS visualization infrastructure, develop and implement an evolving system architecture that enables the creation of computer graphic visualization products of very high quality from large amounts of scientific data in a timely manner;
 - 2.2. Support existing SVS display systems and implement new display systems as an integral part the evolving visualization system architecture;
 - 2.3. Maintain and support the existing visualization systems that the SVS has previously implemented for external customers, in particular the hyperwall systems at NASA/GSFC and the Web Mapping Service (WMS) system on the data portal of the NASA Center for Climate Simulation (NCCS).
 - 2.4. Propose, design and implement data visualization and display systems or system architectures for external users based on the requirements and budget defined by the sponsor for those systems;
 - 2.5. Develop new data visualization software or adapt existing visualization software and systems as necessary to meet the requirements for new and existing visualization systems and visualization capabilities.
3. Develop new paradigms, processes, and software tools that improve the visualization capability of the SVS and its customers. The contractor shall:

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- 3.1. Identify data visualization requirements for new and innovative data representations, test new representations of such data, and implement successful representations within the SVS infrastructure or within external customers' systems;
- 3.2. Develop processes for acquiring and accessing scientific data of new types and in new formats and incorporate those processes within the SVS infrastructure;
- 3.3. Propose specific projects and presentation venues by which to make the NASA community aware of the new paradigms and processes developed within the SVS;
- 3.4. Maintain the proficiency of staff in current visualization techniques and technologies by appropriate training and participation in conferences appropriate to this field.
4. Provide ancillary support to the efforts of the SVS as required to efficiently plan and organize SVS projects, report on those projects to NASA management, and obtain the maximum utility and distribution of SVS products and systems to the NASA community and the general public. The contractor shall:
 - 4.1. Provide project management to support timely planning, accurate resource and personnel allocation, and required reporting to NASA sponsors and management;
 - 4.2. Provide content development for SVS projects in the form of script development, web authoring and design, and content management;
 - 4.3. Support the development and evolution of the database of SVS content that underlies the SVS web site and distribution services and of any resource allocation and reporting tools necessary for SVS projects;
 - 4.4. Support SVS and NASA outreach efforts to conferences, museums, science centers, documentary producers, and the media that utilize SVS materials and systems by, for example, on-site participation, direct consultation, and assistance with NASA in-house demonstrations and activities.

4.0 Reporting

The contractor shall report all work completed/delivered, the status of work in progress, any tasks proposed or in the planning stages, and issues affecting work performance. The contractor shall provide such reports in monthly technical progress meetings held at NASA GSFC with the COTR and/or other designated Government Representatives, and in quarterly written progress reports delivered to the COTR.